TECHNICAL MANUAL

GENERAL

FLUIDS FOR HYDRAULIC EQUIPMENT

(ATOS)

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Prepared By: TRI-COR Industries, Inc.

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LIST OF EFFECTIVE PAGES

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NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Dates of issue for original and changed pages are:

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INTRODUCTION

1. SCOPE.

The instructions contained herein cover the types of hydraulic fluids, their use, and quality control. The individual equipment technical order should be referred to for specific requirements of servicing. This Technical Order (TO) also will cover the disposition of the used hydraulic fluid and its containers. The general types of hydraulic fluid used on current Air Force aircraft will be discussed, but for specific requirements for use the Aircraft TO manual will take precedents.

2. PURPOSE.

The Air Force uses a variety of different types of hydraulic fluid, for both ground and aircraft base equipment, depending on the different types of equipment it is used on. This TO is meant to clarify the use and disposition of hydraulic fluid used in the Air Force inventory.

3. PERSONAL PROTECTIVE EQUIPMENT.

WARNING

Protective clothing will be worn when handling containers and servicing equipment with hydraulic fluid. Hydraulic fluids often contain additives, which may affect the skin, eyes, and respiratory tract. These additives can be readily absorbed through the skin. Ensure fluid does not remain on skin. Use in a well-ventilated area and avoid breathing of vapors. Keep away from sparks and flames. Failure to comply may result in serious injury or death.

Protective clothing such as neoprene gloves, apron, and safety goggles/face shield shall be worn as required by the Base Bioenvironmental Engineer when handling the following fluids: MIL-PRF-5606 (formerly MIL-H-5606), MIL-PRF-6083 (formerly MIL-H-6083), MIL-H-19457, MIL-PRF-83282 (formerly MIL-H-83282), MIL-PRF-46170 (formerly MIL-H-46170), MIL-PRF-87257 (formerly MIL-H-87257), SAE AS1241, Type IV (formerly BMS 3-11), also known by the trade names Skydrol LD-4, Skydrol 500B-4 or Hyjet IV-A, and SAE AS1241, Type V also known by the trade name Skydrol 5.

CHAPTER 1
HYDRAULIC FLUID SPECIFICATIONS

1.1 SPECIFICATION.

There are different types of hydraulic fluids with a wide range of chemical makeup in use throughout the Air Force and the other services. The common types of hydraulic fluid used in the Air Force are covered by Specifications with a Qualified Products Listing (QPL). The common hydraulic fluids, and associated products specifications with QPLs, are MIL-PRF-5606, MIL-PRF-27601, MIL-PRF-83282, and MIL-PRF-87257. The preparing activity for these specifications is Air Force 11 [Air Force Aeronautical Systems Center (ASC), Wright-Patterson AFB OH]. The contact Mailing Address is:

Air Force Research Laboratory
AFRL/MLBT
Building 654, 2941 P Street, Room 136
Wright-Patterson AFB OH 45433-7750

1.2 THRESHOLD LIMIT VALUE.

WARNING

If the concentration level of Tricresyl Phosphate (TCP) exceeds the Threshold Limit Value (TLV) in the atmosphere as dust, vapors, or mist for appreciable periods, damage to a persons health can occur. Wear approved safety breathing masks in areas that have the TLV above recommended concentrations.

Some of the petroleum and synthetic type hydraulic fluid specifications contain TCP as additives. TCP is toxic and has a TLV of 0.1 milligram per cubic meter. TLV is defined as the maximum average concentrations of contaminants to which workers may be exposed for an 8-hour work shift, day after day, without injury to health.

1.3 NATO SYMBOLS.

The NATO symbols for standardized fluids referenced herein are contained in TO 42B1-1-15, NATO/ASCC INTERCHANGEABILITY AVIATION FUELS, LUBRICANTS AND ALLIED PRODUCTS. The standardized products listed in TO 42B1-1-15 are suitable for use in USAF equipment without additional technical guidance.

1.4 ASSISTANCE.

a. For technical assistance or clarification of this TO contact the Air Force Petroleum (AFPET) Office, Wright-Patterson AFB OH. The Weapon Systems Support Branch (AFTT) prepares this technical order and provides technical support for hydraulic related matters. The contact Mailing Address is:

   DET 3, WR-ALC/AFTT
   2430 C Street, Building 70, Area B
   Wright-Patterson AFB, OH 45433-7750

b. For laboratory testing of hydraulic fluid that cannot be preformed by base level laboratories contact the nearest Aerospace Fuels Laboratory. The three CONUS and two OCONUS Aerospace Fuels Laboratories contact information can be found in Table 1-1.

Table 1-1. Aerospace Fuels Laboratory Addresses

	Wright Patterson OH (AFTLA)	Searsport ME * (AFTLB)	Mildenhall UK (AFTLF)	Kadena AB JA (AFTLG)	Vandenberg CA (AFTLE)
Freight Address	(FP2070) OL DET 3 WR-ALC/AFTLA 2430 C St, Bldg 70 Area B Wright Patterson AFB, OH 45433-7632	(FP2071) OL DET 3 WR-ALC/AFTLB Trundy Rd, Bldg 14 Searsport ME 04974	(FP2080) OL DET 3 WR-ALC/AFTLF Bldg 725 Mildenhall AB UK APO AE 09459-5000	(FP2083) OL DET 3 WR-ALC/AFTLG Unit 5161 Kadena AB JA APO AP 96368-5161	(FP2075) OL DET 3, WR-ALC/AFTLE 1747 Utah Ave. Bldg 6670 Vandenberg AFB, CA 93437-5220
Correspondence Address	OL DET 3 WR-ALC/AFTLA 2430 C St Bldg 70 Area B Wright Patterson AFB, OH 45433-7632	OL DET 3 WR-ALC/AFTLB PO Box 408, Bldg 14 Searsport ME 0497-04084	OL DET 3 WR-ALC/AFTLF Unit 5025 APO AE 09459-5000	OL DET 3 WR-ALC/AFTLG Unit 5161 APO AP 96368-5161	OL DET 3, WR-ALC/AFTLE 1747 Utah Ave. Bldg 6670 Vandenberg AFB, CA 93437-5220
Telephone DSN: Commercial:	785-2106 (937) 255-2106	None (207) 548-2451	314-238-2043/2797 44-1-638-54-2043/2797	315-634-3394/1602 011-81-611-734-1602	276-2756 (805) 606-6263
Fax DSN: Commercial:	785-8051 (937) 255-8051	None (207) 548-0351	314-238-3626 44-1-638-54-3626	315-634-1429 011-81-611-734-0584	None (805) 606-2756

* NOTE: Due to laboratory consolidation, AFTLB, will be closing 1 May 2005. After 1 May 2005 all AFTLB (Searsport, ME) samples should be redirected to AFTLA (Wright-Patterson AFB, OH).

CHAPTER 2
SELECTION AND USE OF HYDRAULIC FLUIDS

2.1 SELECTION OF HYDRAULIC FLUIDS.

In selecting the proper hydraulic fluid to be used, consult the appropriate handbook applicable to the particular aircraft or equipment and/or the instruction plate affixed to the individual hydraulic unit or system reservoir. The color of the hydraulic fluid drained from the unit or systems should also be noted. Any indication of the use of incorrect fluid in hydraulic systems or components, or any discrepancy encountered in the handbook or on the instruction plate regarding the fluid to be used will be referred to the appropriate engineering activity for the equipment or system for resolution. Any change directed by the engineering activity should be forwarded to: DET 3 WR-ALC/AFTT, 2430 C STREET, BLDG 70, AREA B, WRIGHT PATTERSON AFB, OH 45433-7632, DSN 785-8050

2.2 USE OF HYDRAULIC FLUIDS.

CAUTION

Utmost care must be taken when it is necessary to replace hydraulic fluids in a system. Compatibility and interchangeability such as that present in the three hydrocarbon based Milspec reds (MIL-PRF-5606, MIL-PRF-83282, and MIL-PRF-87257) must be proven and its suitability for each aircraft tested. Do not mix dissimilar hydraulic fluids, such as hydrocarbon based with phosphate ester based (i.e., Hyjet and Skydrol), in the same system. Damage to equipment could result.

NOTE

MIL-PRF-5606, MIL-PRF-83282, and MIL-PRF-87257 are totally miscible and compatible (see Table 8-1). For aircraft hydraulic system servicing, see Chapter 10 and refer to the applicable aircraft servicing technical data. Aerospace Ground Equipment (AGE) should be serviced with fluid applicable to the aircraft it connects to (when the AGE and aircraft fluids are interchanged). AGE that does not interchange fluid with the aircraft system (such as maintenance stands, jacks, and jacking manifolds) may be serviced with a compatible fluid unless prohibited by the applicable technical order.

Most USAF aircraft designed to use MIL-PRF-5606 petroleum base hydraulic fluid have been converted to MIL-PRF-83282 or MIL-PRF-87257, synthetic hydrocarbon base fire resistant hydraulic fluids. Some aircraft managers are still conducting tests to determine the suitability of MIL-PRF-87257 for their systems. Certain aircraft will continue to use MIL-PRF-5606. Other models are procured as OFF-THE-SHELF commercial aircraft and require SAE AS1241, Type IV, synthetic phosphate ester hydraulic fluid. It should never be assumed that all aircraft, or even all systems within a particular aircraft, use the same type of hydraulic fluid. Caution must be exercised at all times to assure that dissimilar fluids do not become mixed in use.

CHAPTER 3
TYPES OF HYDRAULIC FLUID

3.1 WATER TYPE HYDRAULIC FLUIDS.

Water mixtures and emulsion are used in applications where moderate temperatures of 0°C (32°F) to 65.5°C (150°F) are encountered, and where fire resistance is required. These fluids may be used satisfactorily in hydraulic systems containing vane, gear and axial-piston pumps at moderate pressures. Water type fluids are compatible with the common materials of construction, such as steel, aluminum, brass and copper. Galvanized and cadmium plated metals should not be used. Aqueous type fluids have no deleterious effects on various sealing and packing materials normally designed for petroleum fluids. One exception is cork-impregnated seals, which are attacked by water. Applicable specifications are as follows:

a. MIL-H-5559, Hydraulic Fluid, Arresting Gear, has been cancelled. Use A-A-59290.

b. MIL-H-13910, Hydraulic Fluid, Polar Type Automotive Brake, All Weather, has been cancelled. Use MIL-PRF-46176.

c. MIL-H-22072, Hydraulic Fluid, Catapult. This fluid is fire resistant and is intended for use as a power transmission medium for hydraulic actuated systems in aircraft launching catapults.

d. A-A-59290, Hydraulic Fluid, Arresting Gear. This fluid is approximately 94% ethylene glycol and is intended for use in aircraft arresting gear systems. It is not interchangeable with any other type or grade of hydraulic fluid.

3.2 PETROLEUM TYPE HYDRAULIC FLUIDS.

Petroleum type hydraulic fluids are the most widely used of the various type fluids. Petroleum type hydraulic fluids are used in some aircraft control and utility systems, missile control systems, steam turbines, hydraulic turbine governors, ground vehicles and machine tools. Desirable characteristics are good viscosity index (permitting operation over a wide temperature range), resistance to oxidation, long operational life, wear resistance properties, rust protection, demulsibility (permitting the rapid separation of water), and resistance to foaming. The most important undesirable characteristic is flammability. Applicable specifications are as follows:

a. MIL-PRF-5606, Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance. This fluid is intended for use in automatic pilots, shock absorbers, brakes, flap-control mechanisms, missile hydraulic servo-controlled systems and other hydraulic systems using synthetic sealing material. It is suitable for use within a temperature range of −54°C (−65°F) to +71°C (+160°F) in open systems and up to +135°C (+275°F) in closed airless systems.

NOTE

Introduction of MIL-PRF-6083 into the aircraft hydraulic system should be avoided. Ensure hydraulic system components that have been stored in MIL-PRF-6083 as a preservative medium are thoroughly drained before installation.

b. MIL-PRF-6083, Hydraulic Fluid, Petroleum Base, for Preservation and Operation. This fluid is intended for use as an operational fluid where corrosion protection is required and a determination has been made that MIL-PRF-46170 cannot be used. This includes use in recoil mechanisms and hydraulic systems for rotating weapons or aiming devices of tactical and support ordnance equipment, except combat armored vehicles/equipment that require MIL-PRF-46170. It is the rust inhibited version of MIL-PRF-5606 and is also used as a preservative medium for hydraulic systems and components which use MIL-PRF-5606 or MIL-PRF-87257. It is suitable for use within a temperature range of −54°C (−65°F) to +135°C (+275°F).

c. MIL-H-13919, Hydraulic Fluid, Petroleum Base, Fire Control, has been cancelled. Use MIL-PRF-46170.

d. MIL-DTL-17111, Fluid, Power Transmission. This fluid is intended for use in the hydraulic transmission of power.

e. MIL-PRF-17672, Hydraulic Fluid, Petroleum, Inhibited. This specification covers three grades of fluid. It is intended for use in shipboard hydraulic systems not requiring the use of fire-resistant hydraulic fluid and in other applications where anticorrosion and antioxidation properties are required.

f. MIL-H-24459, Hydraulic Fluid, Antiwear, Petroleum Base, has been cancelled. Use MIL-PRF-17672.

g. MIL-H-46001, Hydraulic Fluids, Petroleum Base, for Machine Tools, has been cancelled. Use A-A-59354.

h. MIL-H-46004, Hydraulic Fluid, Petroleum Base, Missile, has been cancelled. Use MIL-PRF-5606 or MIL-PRF-87257.

i. A-A-59354, Hydraulic Fluids, Petroleum Base, for Machine Tools. This specification covers four types of fluids. It is intended for use in hydraulic systems of metalworking machine tools that require anti-wear oil. The selection of viscosity grade should be based on the recommendation of the machine tool manufacturer.

j. MIL-H-81019, Hydraulic Fluid, Petroleum Base, Ultra-Low Temperature. This fluid is intended for use in automatic pilots, shock absorbers, brakes, flap-control mechanisms, missile hydraulic servo-controller systems and other hydraulic systems using synthetic sealing material. It is suitable for use within a temperature range of −70°C (−94°F) to +100°C (+212°F). This fluid is not interchangeable with any other type or grade of hydraulic fluid except MIL-PRF-5606 or MIL-PRF-87257 in emergencies.

3.3 VEGETABLE TYPE HYDRAULIC FLUIDS.

These fluids are not used by the Air Force. No military specification presently exists for vegetable oil type fluids.

a. MIL-F-7644, Hydraulic Fluid (Castor Oil Base), has been cancelled. Use MIL-PRF-5606.

b. MIL-P-46046, Preservative Fluid, Automotive Brake System and Components, has been cancelled. Use MIL-PRF-46176.

3.4 SYNTHETIC TYPE HYDRAULIC FLUID.

Synthetic hydraulic fluids include organophosphorus compounds, halogenated hydrocarbons, organic esters, silicones and hydrocarbons. Applicable specifications are as follows:

a. VV-D-1078, Damping Fluid, Silicone Base (Dimethylpolysiloxane). This specification covers several viscosity grades of a synthetic silicone fluid. The fluid is intended for use as a damping fluid, transducer fluid, lubricant, heat transfer fluid, dielectric fluid, mold release agent, water-repellent, hydraulic fluid, and protective dressing and impregnant. The lower viscosity fluids tend to cause certain elastomers to shrink and harden. Consideration should be given to the type of elastomer used when in contact with these fluids. Silicone fluids are nonvolatile, have good viscosity temperature properties, are fire resistant and are not affected by atmospheric conditions. These fluids have poor lubricating qualities.

b. SAE AS1241, Fire Resistant Phosphate Ester Hydraulic Fluid, Type IV. Hydraulic fluids meeting this specification are procured for use in USAF special purpose commercial aircraft (T-43, C-137, E-4, and C-9). These fluids, also known by the trade names Skydrol LD-4, Skydrol 500B-4 and Hyjet IV-A, are not compatible with MIL-PRF-5606, MIL-PRF-83282 or MIL-PRF-87257 aircraft hydraulic fluids. Mixing of commercial aircraft hydraulic fluids with other types of aircraft hydraulic fluid could result in a flight safety incident.

c. MIL-H-19457, Hydraulic Fluid, Fire-Resistant, Non-neurotoxic. This fluid is phosphate ester base. It is intended for use as a fire-resistant power transmission fluid for accumulator loaded shipboard hydraulic systems that operate at pressures exceeding 600 lb/in.^{2} gauge. Specific applications include aircraft carrier elevators, weapon handling systems, and centrifuges in closed areas where fire resistant fluid is required. The fluid has good lubricating properties, especially steel-on-steel.

d. MIL-PRF-27601, Hydraulic Fluid, Fire Resistant, Hydrogenated Polyalphaolefin Base, High Temperature, Flight Vehicle, Metric. This fluid is intended for use in hydraulic systems of flight vehicles over the temperature range of −40°C (−40°F) to +290°C (+554°F).

NOTE

Introduction of MIL-PRF-46170 and MIL-PRF-6083 into the aircraft hydraulic system should be avoided. Ensure hydraulic system components that have been stored in MIL-PRF-46170 or MIL-PRF-6083 as a preservative medium are thoroughly drained before installation. Because a very small amount of residual MIL-PRF-46170, Type II in drained hydraulic system components has caused operational problems in certain aircraft systems, Type II fluid will no longer be available. Aircraft hydraulic system parts may use the functional fluid used in that aircraft, i.e., MIL-PRF-83282, MIL-PRF-87257, or MIL-PRF-5606 for component storage. When used as component storage fluids, MIL-PRF-83282, MIL-PRF-87257, and MIL-PRF-5606 do not require draining prior to the component being installed on the aircraft. Contact appropriate System Program Office (SPO) for recommended alternate fluid for storage.

e. MIL-PRF-46170, Hydraulic Fluid, Rust Inhibited, Fire Resistant, Synthetic Hydrocarbon Base. This fluid is intended for use in recoil mechanisms and hydraulic systems of military ground vehicles and

equipment. If used in other mechanisms or systems, a study should be made to determine its applicability for such usage, with particular attention given to operation at high and low temperature and the topic of elastomer compatibility. It is the rust inhibited version of MIL-PRF-83282 and may be used as a preservative medium for ground hydraulic systems and components which use MIL-PRF-83282. The hydraulic fluid has a wide range of operating temperatures, it is thermally stable, corrosion inhibited and fire resistant.

f. MIL-PRF-46176, Brake Fluid, Silicone, Automotive All Weather, Operational and Preservative. This fluid is military unique due to the requirement that it perform at a minimum ambient temperature of –55°C (–67°F). It is intended for use as an operational and preservative fluid in automotive hydraulic brake systems at ambient temperatures ranging from –55°C (–67°F) to +55°C (+131°F) and fluid temperatures ranging from –55°C (–67°F) to +205°C (+401°F).

CAUTION

Refer to Table 10-1 for specified purity percentages that must be maintained in instances where an aircraft can use alternate fluids. If guidance is not followed damage to aircraft parts may occur.

g. MIL-PRF-83282, Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Metric. This fluid does not have viscosity improver additives. It is intended for use from –40°C (–40°F) to +205°C (+401°F) in automatic pilots, shock absorbers, air compressor gear boxes, brakes, flap-control mechanisms, missile hydraulic servo-controlled systems and other hydraulic systems using synthetic sealing materials. MIL-PRF-83282 is considered to be an acceptable emergency substitute for either MIL-PRF-5606 or MIL-PRF-87257. Some USAF aircraft have been converted to MIL-PRF-83282 in lieu of MIL-PRF-5606; however, certain aircraft will not be converted because of low temperature operation considerations. Servicing of MIL-PRF-83282 into those specific aircraft, where MIL-PRF-5606 is the only specified fluid, is not authorized.

NOTE

MIL-PRF-46170, Type II for aircraft hydraulic component storage will no longer be available. Aircraft hydraulic system parts may use the functional fluid used in that aircraft, i.e. MIL-PRF-83282, MIL-PRF-87257, or MIL-PRF-5606 for component storage. When used as component storage fluids, MIL-PRF-83282, MIL-PRF-87257, and MIL-PRF-5606 do not require draining prior to the component being installed on the aircraft. Contact appropriate SPO for recommended alternate fluid for storage.

h. MIL-PRF-87257, Hydraulic Fluid, Fire Resistant, Low Temperature, Synthetic Hydrocarbon Base, Aircraft and Missile. This fluid does not have viscosity improver additives. It is intended for use from –54°C (–65°F) to +200°C (+392°F) in automatic pilots, shock absorbers, brakes, flap-control mechanisms, missile hydraulic servo-controlled systems, and other hydraulic systems using synthetic sealing material. This fluid is completely compatible with MIL-PRF-5606, MIL-PRF-6083, MIL-PRF-46170 and MIL-PRF-83282 hydraulic fluids. It may be interchangeable with these fluids for some applications. The selection of the fluids to be used depends on the requirements of the operational system. Some USAF aircraft have been converted to MIL-PRF-87257 in lieu of MIL-PRF-5606.

CHAPTER 4
QUALITY CONTROL AT BASE LEVEL

4.1 GENERAL.

a. The purpose of this section is to establish minimum quality control procedures that will be followed by personnel. This will provide a means of evaluating the cleanliness of hydraulic fluid handling equipment. In order to benefit from the various observations, tests and calculations, results must be translated into meaningful terms, and evaluated along with other criteria before appropriate actions are initiated.

b. In subsequent paragraphs, general criteria are listed which give an indication of where to apply corrective action. If corrective action does not resolve the problem, technical assistance may be obtained from DET 3, WR-ALC/AFTT, 2430 C STREET, BLDG 70, AREA B, WRIGHT-PATTERSON AFB, OH 45433-7632, DSN 785-8050.

4.2 RESPONSIBILITY.

a. The base maintenance officer is responsible for the dispensing of hydraulic fluids to equipment (Aerospace Ground Equipment (AGE) and aircraft) to safeguard quality and preserve suitability of service. Logical arrangement, adequate protection of stocks and adherence to good housekeeping are important factors in attaining these objectives. In this connection, attention is called to the following:

(1) Personnel should be quality conscious at all times.

(2) Maintain cleanliness.

(3) Always keep hydraulic fluid segregated and properly identified.

(4) Whenever possible, store hydraulic fluid in places that indoor temperatures prevail.

(5) Read the label before dispensing hydraulic fluid to assure that the correct material is being used.

(6) Never retain partially filled containers (quarts or gallons) of hydraulic fluid for future use in servicing aircraft hydraulic systems.

(a) The only exceptions to this requirement is for unused fluid, from new containers that have been opened, can be used for strut cleaning or lubrication purposes and may be retained. Since the cleanliness standards for aircraft hydraulic systems do not apply when the fluid is being used in this application.

(b) The unused fluid should be transferred to a plastic pump handle bottle, which can be used to apply fluid to the struts, or to a bottle (either metal or plastic) having a screw cap. The bottle must be marked: Hydraulic Fluid for Strut Cleaning Only – Do Not Use In Aircraft Hydraulic Systems. The unused hydraulic fluid from containers opened for servicing aircraft passenger recline systems may be saved and kept in an approved metal servicing container stenciled: Hydraulic Fluid for Servicing Aircraft Seats Only.

(7) Open containers only with approved opening devices. Do not use maintenance tools such as screwdrivers.

b. The base maintenance officer is responsible for sampling the hydraulic fluid being dispensed to aircraft to assure that it conforms to the requirements set forth in applicable handbooks, technical manuals, or specifications.

c. The base maintenance officer is responsible for sending samples for testing. Quality control tests on hydraulic fluids may be obtained by sending a one-gallon size sample of the suspected contaminated fluid to the area laboratory specified in Table 1-1.

4.3 SAMPLING REQUIREMENTS.

Size of sample and frequency of sampling servicing equipment will normally be governed by applicable handbooks, technical manuals or operating procedures. Variations may be authorized at the discretion of the base maintenance officer if there is reason to suspect contamination.

a. A sample should be sent to the area laboratory for confirmation of contamination. If contamination is confirmed, fluid may be purified following Paragraph 4.4, if applicable.

b. Sampling of aircraft will not be made except to confirm the presence of contamination.

4.4 FLUID PURIFICATION.

Purification is the removal of particulate, water and volatile contaminants from the fluid without altering the physical or chemical properties. Fluid purification allows reduction of

hydraulic fluid in the waste stream and possibly improved system performance.

a. Purification is approved for:

- MIL-PRF-83282
- MIL-PRF-87257
- MIL-PRF-5606
- Mixtures of MIL-PRF-83282, MIL-PRF-87257, and MIL-PRF-5606

NOTE

Although the fluid purification process itself does not reduce the viscosity of MIL-PRF-5606, use in aircraft hydraulic systems does reduce the viscosity due to the breakdown of the viscosity index improver.

b. Use of purified hydraulic fluid is permitted if the following requirements have been met:

(1) The applicable aircraft SPO has approved the use of purified hydraulic fluid.

(2) Only approved units are used to accomplish purification of the fluid. Test stands with built-in purifiers currently approved for use are:

- NSN 4920-01-380-7460
- NSN 4920-01-380-4744
- NSN 4920-01-434-1081
- NSN 4920-01-434-3206

(3) A list of approved stand alone purifiers can be found on the HFP IPT website at https://www.aekm.wpafb.af.mil/EnterHomeP.jsp?id=EnterpriseHome.AEKM.1095864196124.

(4) Any deviation from this list must be approved by AFRL/MLBT, Wright-Patterson AFB OH. AFRL/MLBT will notify DET 3, WR-ALC/AFTT of any changes or additions to this list.

c. If hydraulic fluid is suspected of being contaminated with fuel and/or flammable material (material having a closed cup flash point of less than 40°C (104°F)), send a 1 – 4 oz sample for testing to Aerospace Fuels Laboratory, DET 3, WR-ALC/AFTLA, 2430 C Street, Bldg 70, Area B, Wright-Patterson AFB, OH 45433.

WARNING

Hydraulic fluid suspected of being heavily contaminated with flammable material (material having a closed cup flash point of less than 40°C (104°F)), should not be purified with purification units that warn against it. These units do not have explosion-proof motors and an explosion may result.

d. Purification units will only be attached to portable hydraulic test stands or service carts. Purification units may be attached directly to the aircraft only with aircraft SPO approval.

e. Collection of fluid in bulk storage containers and subsequent purification of that fluid is not permitted for aircraft use.

4.5 QUALITY CONTROL TESTS.

The following Quality Control Tests identify (depending on the different fluid types) the kind of tests that should be preformed anytime contamination is suspected. Except for water-based hydraulic fluids, water content is an important parameter in determining hydraulic fluid contamination. The water content must fall within appropriate concentration ranges.

a. WATER TYPE HYDRAULICS FLUIDS – Tests should be conducted at 3-month intervals on systems utilizing water-base fluids. These tests should include viscosity, pH value and sediment or fiber content. Since the viscosity will increase if the water evaporates from the fluid, viscosity is a convenient means of measuring water content. If evaporation of water from the fluid has occurred, it may be returned to its original consistency by addition of the proper quantity of water. Only distilled, deionized or steam condensate should be used since hard water may cause inhibitor precipitation.

b. PETROLEUM TYPE HYDRAULIC FLUIDS – Tests should include viscosity, neutralization number, corrosiveness and oxidation, chlorine contamination, barium content, particulate matter, and water content. Tests will be performed in accordance with the applicable specification.

c. ORGANOPHOSPHORUS FLUIDS – Tests should include viscosity, pour point, neutralization number, emulsion, corrosion, fire resistance, and water content.

d. HALOGEN CONTAINING FLUIDS – Tests should include viscosity, neutralization number, hydrolytic stability, and water content.

e. ESTER TYPE HYDRAULIC FLUIDS – Tests should include viscosity, oxidation stability, neutralization number, and water content.

f. SILICONE FLUIDS – Tests should include viscosity, viscosity-temperature coefficient, pour point, flash point, neutralization number, and water content.

g. SYNTHETIC HYDROCARBONS – Tests should include viscosity, oxidation stability, neutralization number, barium content, chlorine contamination particulate matter, and water content.

4.6 VISUAL INSPECTION.

NOTE

NSN 8125-01-477-9105 sample bottles are precleaned and do not require cleaning prior to taking the fluid sample. Keep bottle capped until ready to take sample.

a. Collect a sample of fluid to be tested in a precleaned glass bottle (NSN 8125-01-477-9105).

b. Check for proper color and visual contamination by swirling the sample so that a vortex is formed. Any sediment or water present will accumulate on the bottom of the bottle directly beneath the vortex. If any visible sediment, fine suspended solids or water is present, isolate the system or equipment and submit a sample to the area Aerospace Fuels Laboratory for verification of the quantity of contamination.

4.7 SAMPLING PROCEDURE.

Since hydraulic fluid samples can come from various locations or sources on different types of systems, no one sampling technique will be specified in this TO. The following general requirements and precautions are recommended to insure a representative sample is taken whichever technique is used.

a. All samples should be sent to the nearest area Aerospace Fuels Laboratory listed in Table 1-1. Use sample kit NSN 8125-01-477-9105, which contains a 8-ounce pre-cleaned bottle and includes an overpack for shipping, when taking sample for test.

b. When possible, prior to taking the sample, clean the fitting, tubing, sampling valve, etc. from which the sample will be taken with clean solvent (e.g., A-A-59601 (PD680), alcohol, etc.). Let the residual solvent evaporate. Allow at least one quart (approximately) to flow through the tubing, valve, etc. from which the sample will be taken, then take the actual sample.

c. Open sample bottle and discard plastic film. Insert the bottle into the stream and fill to within approximately one inch of the top of the sample bottle. Do not fill the bottle completely full. Then immediately tighten the cap. Tighten sufficiently to ensure the cap does not back off during shipping. Label the bottle with the aircraft or ground support equipment number, the date the sample was taken, the location from which the sample was taken and any other pertinent information. An AFTO 475 should be completed and attached to the bottle. Put bottle in the shipping container.

d. Vermiculite or similar loose, flake material SHALL NOT be used as packing material because of possible particulate contamination. Pack the sample in the specified over pack or with PPP-C-1797 Cushioning Material, Resilient, Low Density, Unicellular, Polypropylene Foam or similar packing material.

CHAPTER 5
DISPOSITION OF USED FLUID AND FLUID CONTAINERS

5.1 DISPOSITION OF FLUIDS.

Reclamation is the process of removing contaminants from the fluid and then revitalizing the fluid's additives. Reclamation can be accomplished by mechanical means, chemical reprocessing, re-refining and/or electrostatic filtration. Reclamation of used hydraulic fluid by service activities is not authorized. When it has been determined that a hydraulic fluid is no longer suitable for use in aircraft, this material will be tagged accordingly and disposed of as administratively condemned property in accordance with TO 42B-1-23, Management of Recoverable and Waste Liquid Petroleum Products. Reclamation should not be confused with purification of fluid. Reference Paragraph 4.4 to see if fluid purification is applicable.

NOTE

Any fluid remaining in open quart or gallon containers after equipment servicing will not be retained for future use, but will be disposed of as used fluid unless it can be consumed for strut cleaning/lubrication purposes (see Paragraph 4.2a (6)). Hydraulic fluids will not be disposed of in sanitary or storm sewers, or in open ditches. Contact the Base Civil Engineer or the Environmental Coordinator for approved methods of disposal. This procedure is considered necessary to eliminate the possibility of using contaminated fluid.

5.2 DISPOSITION OF CONTAINERS.

The importance of cleanliness in hydraulic system maintenance cannot be over emphasized. Trouble free operation of hydraulic systems depends in part on the effort expended to assure the use of clean hydraulic fluid. Hydraulic fluid is packaged in drums and in hermetically sealed containers to preclude the possibility of contamination either of the fluid or of hydraulic equipment serviced therewith. Quart or gallon containers, when emptied, will be rendered useless as such and disposed of in accordance with existing base regulations. Empty drums will be disposed of in accordance with AFMAN 23-110, USAF Supply Manual, VOL 1, PT 3, CHAP 1, SECT 1B, PARA 1.36.

CHAPTER 6
SELECTION AND USE OF CLEANING MATERIALS

6.1 INTRODUCTION.

This section provides information for guidance in the selection and use of cleaning solvents and wiping materials.

6.2 CLEANING SOLVENTS.

Since cleaning agents (solvents) are frequently used in performing hydraulic system maintenance, the selection of an appropriate agent is an important consideration. The cleaning agent selected must be compatible with the cleaning method used, with the materials used in construction of the system, and must also be capable of removing unwanted substances to the desired degree. Many solvents, in addition, present characteristic safety hazards. It is of the utmost importance that the user be aware of the hazards and exercise the required safety precautions. Disregard for any of these factors can result in incomplete cleaning, damage to equipment, and/or injury to personnel.

6.3 SOLVENT CLEANLINESS.

Most cleaning compound specifications do not impose stringent requirements on the cleanliness of the fluid supplied. For critical cleaning applications it is therefore required that the solvent be passed through a 3-micron (absolute) filter prior to use.

6.4 SOLVENT EFFECTIVENESS.

Solvent power, or effectiveness as a dissolving agent, can be measured in many ways. In order to be comparative, however, a known or established standard must be used. For purposes of standardization, the solvent industry has adopted a test method known as the Kauri Butanol (K-B) system. Solvent power as expressed by K-B values is the amount of solvent which, when added to a standard kauri gum-butanol solution, will produce a specified degree of turbidity or cloudiness. Since in most cases 100 ml of benzene will produce the specified level, the K-B number for benzene is 100.0, and it serves as an arbitrarily accepted reference. K-B values serve as a guide or index of relative solvency power. Generally, the higher the K-B number the more effective the solvent is considered to be. It must be emphasized, however, that K-B values may not always be indicative of the most effective solvent for a particular cleaning situation. Other factors such a temperature, time, cleaning method, and materials must also be considered, with the result that a solvent having a relatively low K-B value may often be best suited for a particular task. K-B values for some representative and commonly used solvents are listed in Table 6-1.

6.5 SOLVENT TOXICITY.

The American Conference of Government Industrial Hygienists (ACGIH) publishes a guide on the toxicity of solvents and other substances. The guide provides recommended Threshold Limit Values (TLV), which represent maximum concentrations in the air of substances to which it is believed personnel may be repeatedly exposed, day after day, without adverse effect. These limits are usually stated as parts of the solvent vapor per million parts of air, compared on a volume basis. The highest recommended TLV for any solvent is 1,000 ppm with some commonly used solvents having a TLV as low as 100. To ensure personnel safety it is imperative that exposure to solvent vapors is limited to values less than the recommended TLV. Refer to Table 6-1 for the TLV of solvents commonly used in aircraft maintenance.

6.6 SOLVENT FLAMMABILITY.

Exposure to high temperature may dangerously increase the volatility of many solvents and should be avoided. In addition to producing high concentration levels, elevated temperatures may result in the formation of toxic or acidic fumes, or possibly explosive mixtures. Ensure adequate ventilation at all times and avoid solvent vapor contact with hot surfaces or open flame. Flash point, fire point, and autoignition point are the three temperature values used to determine the flammability of a solvent.

a. Flash Point. The flash point is the lowest temperature at which sufficient vapor is given off to produce momentary ignition when exposed to a specified flame. Several different test methods are employed to determine flash point, all of which involve raising the temperature of the liquid under test, under specified conditions. The test-measured flash point actually represents the lowest temperature, in a worst-case situation, under which combustion can occur momentarily. The flash point rating provides an indication of the ease with which a solvent can be ignited and indicates its relative flammability. Table 6-1 lists the minimum required flash points for solvent materials commonly used in aircraft hydraulic maintenance. In order for a fluid to burn continuously, or to ignite spontaneously without an external ignition source, it is necessary that the fluid be raised to a temperature that is higher than its rated flash point. These temperatures are the fire point and autoignition point respectively, and in effect describe the safe operating temperature limits more realistically.

b. Fire Point. The fire point is the lowest temperature at which a volatile combustible substance will burn continuously in air once its vapors have been ignited. This value is also indicative of the relative flammability of a solvent and is a temperature higher than that of the flash point. The fire point is determined by continuing the flash point test until a temperature that will support continuous combustion is reached.

c. Auto Ignition Point. The autoignition point is the lowest temperature at which a combustible substance, when heated, will self-ignite in air and continues to burn. No external spark or flame is applied and combustion results solely from the temperature rise in the substance. The autoignition point is also indicative of the flammability of a solvent and is always a higher temperature than either the flash or fire point.

6.7 SOLVENT CONTAMINATION.

When inadvertently introduced into an operating hydraulic system, certain cleaning agents can produce severe corrosion of internal metallic surfaces. The cleaning agent in such instances represents an incompatible foreign substance in the system and, as such, is considered a contaminant. Chlorinated solvents are potential sources of operating hydraulic system contamination. When allowed to combine with the minute amounts of water often found in an operating hydraulic system, chlorinated solvents may hydrolyze to form hydrochloric acids. These acids will attack internal metallic surfaces in the system, particularly those that are ferrous, and produce a severe rust-like corrosion. Such corrosion is virtually impossible to arrest and extensive component overhaul and system flushing are generally required to restore the system to operational condition. To prevent solvent contamination, it is imperative that extreme care be exercised when utilizing chlorinated solvents to clean internal surfaces of system components that may come into contact with the hydraulic fluid. If such solvents must be employed, ensure that all surfaces are dry and free of any traces of residual solvent prior to installation or assembly. Clean, unused hydraulic fluid or A-A-59601 (PD680), Type II, Dry Cleaning and Degreasing Solvent is recommended for those cleaning applications where solvent contamination may be a problem.

6.8 SOLVENT SELECTION.

Numerous solvents suitable for use as cleaning agents are available in the Navy supply system. To determine which solvent is best suited for a particular task it is necessary to compare all characteristics of the solvent considered with the detailed requirements of the specific cleaning operation. Important factors to be considered include material to be cleaned, nature of substance to be removed, cleaning method to be used, work environment, and personnel safety requirements. Table 6-1 outlines the important characteristics of commonly available solvents and should be referred to when selecting a solvent.

6.9 SAFETY PRECAUTIONS.

The following safety rules should be made available to and observed by all personnel involved in the use or storage of cleaning agents.

a. Provide adequate ventilation.

b. Always store new or used solvents in clearly labeled containers.

c. Provide eye flooding and shower facilities as needed.

d. Keep containers sealed when not in use.

e. Avoid prolonged or repeated contact with the skin or breathing of vapors.

f. Prohibit smoking, welding, or use of open flame in the vicinity of volatile or flammable solvents.

g. Dispose of contaminated solutions in accordance with local safety regulations.

h. Do not take internally.

i. Use protective devices such as cover or cup-type goggles, face shields, solvent resistant gloves, and other protective clothing, as required.

6.10 FIRST AID.

Table 6-2 presents a general first aid treatment guide for overexposure to cleaning solvents. It is recommended that more specific first aid procedures be prepared and that they be posted in the immediate work area for each type of solvent used.

Table 6-1. Cleaning Product Selection for Use in Hydraulic Maintenance

	Dry Cleaning Solvent PD680 (Procured under Specification A-A-59601)	Hydraulic Fluid MIL-PRF-5606 MIL-PRF-46170 MIL-PRF-83282 MIL-PRF-87257
Effective in Removing	Oil, fat, grease, wax, heavy dirt deposits	Oil, organic matter, light dust or dirt deposits
Cleaning Method	Dip, slosh, spray, brush, flush or wipe	Dip, slosh, spray, brush, flush or wipe
Toxicity	High TLV = 100 ppm	Low TLV = unknown
Flash Point	60°C (140°F)	MIL-PRF-5606 – 93°C (200°F) MIL-PRF-46170 – 204°C (400°F) MIL-PRF-83282 – 204°C (400°F) MIL-PRF-87257 – 175°C (350°F)
K-B Value	29 to 45	Unknown
Advantages	Economical, good chemical stability Effective for gross cleaning application Not chlorinated.	Readily available. Compatible with material used in hydraulic components Not chlorinated.
Disadvantages	Flammable Moderately toxic.	Flammable Not very effective as a solvent. MIL-PRF-46170, MIL-PRF-83282 and MIL-PRF-87257 are fire resistant.
Safety Precautions	Use with full ventilation. Avoid excessive inhalation. Do not use near hot surfaces or open flames.	Do not use near hot surface or open flame. Avoid excessive skin contact.
Recommended Application	Cleaning of surfaces coming into direct contact with system fluid, such as interior of hydraulic reservoirs, filter bowls, etc. General cleaning of all hydraulic components.	As a substitute for A-A-59601 (PD680) when cleaning surfaces which come into direct contact with system fluid.

6.11 WIPING MATERIALS.

a. Wiping materials are commonly used during hydraulic system maintenance to wipe down or to dry exposed surfaces of hydraulic components and associated airframe assemblies. Several types of wiping materials, which differ considerably as to the basic material and characteristics, are presently in common use in the fleet. Improper utilization of wiping materials can constitute, and has proven to be, a source of hydraulic system contamination. It is important, therefore, that maintenance personnel be familiar with the available materials and their proper application.

b. Wiping materials suitable for use in hydraulic system maintenance include rags and towels made of natural or synthetic fibers. All are referred to as DISPOSABLE WIPING CLOTHS; however, some types can be laundered and reused. The type of wiping cloth selected for a given application will be determined by a number of considerations that may include: (1) substances being wiped or absorbed, (2) the amount of absorbency required, and (3) the required degree of cleanliness. For purposes of contamination control, it is convenient to categorize available wiping materials by the degree of lint or built-in debris that they may deposit during use. In critical cleaning applications, such as those encountered during hydraulic component overhaul, this factor itself will often determine the choice of wiping cloth.

c. Three types of lint free synthetic wiping cloths are specified for use in hydraulic maintenance and are presently available in Navy supply. Number 9404 Duralace and A-A-59323, Type I and II are listed in Table 6-3.

(1) Number 9404 Duralace is a non-woven, binder-free, non-snag material. It is primarily intended as a washing, polishing and wiping cloth, for critical dry/solvent wiping use in aircraft maintenance.

(2) A-A-59323, Type I lint free wiping cloths are pre-cleaned to a very low particulate level and supplied in sealed 10-pound bags. Type I wiping cloths are certified ultra-clean and are to be used exclusively in clean rooms and controlled work areas during component rework, repair and test.

(3) A-A-59323, Type II wiping cloths have the same lint free features as Type I, however, are not pre-cleaned to a high cleanliness standard. This material is to be used for general wipe down of hydraulic components, such as struts and actuators, in place of conventional baled rags. Type II wiping cloths are also supplied in 10 pound bags.

d. The synthetic wiping materials described should not be used for wiping down large plastic areas, or with volatile solvents having flash points less than 38°C (100°F), due to the possibility of developing dangerous static charges. Cotton flannel or cheesecloth should be used for these applications. The synthetic wiping materials are ideally suited for most hydraulic maintenance operations, and should be employed whenever possible, to minimize contamination.

6.12 RECOMMENDED WIPING CLOTHS.

Table 6-3 provides information on specific disposable wiping cloths recommended for use in hydraulic system maintenance. The table should be referred to and utilized as a guide when selecting wiping cloths for specific applications.

Table 6-2. First Aid Treatment Guide

Type of Contact	Symptoms	Treatment
Inhalation	Anesthetic or narcotic effect.	Remove to fresh air and obtain immediate medical attention.
	Varies from irritation of nose and throat to dullness, dizziness, headache, stupor, nausea, vomiting and unconsciousness.	Administer artificial respiration if breathing has stopped.
	Death in severe exposures.	Keep patient warm and quiet.
External Contact: Skin	Burning sensation, dermatitis.	Remove any soaked clothing. Wash affected area and apply lanolin ointment, olive oil, or cold cream. Obtain immediate medical attention.
Eyes	Pain, inflammation, tearing.	Flush eyes with large amounts of water. Obtain immediate medical attention.
Oral Intake	Nausea, vomiting, diarrhea, and drowsiness or unconsciousness.	Obtain immediate medical attention.

Table 6-3. Recommended Wiping Cloths

Specification	Rating	Description	Application	Characteristics
CCC-C-46, Type I, Class 7 #9404 Duralace	Low lint	Wiping cloth, non-woven fabric	Wipe-down and drying of critical surfaces having high cleanliness requirements.	Very low lint. Ultra clean. High wetted strength. Good absorbency.
A-A-59323, Type II See CAUTION	Low lint.	Bagged cloth, wipers, synthetic fiber.	Use for general wipe-down of hydraulic components such as struts and actuators.	Low lint and other particulate. Poor water absorbency.
A-A-59323, Type I See CAUTION	Very low lint.	Bagged cloth, wipers, synthetic fiber, certified clean	For use in clean rooms and controlled work areas during component rework, repair, and test. Wipe-down and drying of critical surfaces having high cleanliness requirements.	Very low lint and other particulate. Pre-cleaned to a very low particulate level. Poor water absorbency.
SAE AMS 3819B Class 1, Grade A	Very low lint.	Wiping cloth, woven and unwoven, chemically pure, 100% cotton fibers.	For use in cleaning operations where exceptionally low residual surface contamination levels are required.	Very low lint and other particulate. High absorbent Solvent resistant.

CAUTION

Do not use to wipe plastic areas or use with A-A-59601 (PD680) or volatile solvents having flash points less than 38°C (100°F).

CHAPTER 7
PREPARATION OF HYDRAULIC SYSTEMS AND COMPONENTS FOR SHIPMENT AND STORAGE

7.1 PREPARATION FOR SHIPMENT AND STORAGE.

a. When an aircraft is prepared for storage, a sample of hydraulic fluid will be drawn from the lowest drain point in the system. If the sample is found to be free of sludge and dirt, add a sufficient quantity of new, designated fluid to the reservoir until the proper fluid level is reached. If the fluid sample contains sludge or foreign matter, the system will be drained, flushed and refilled with new, designated fluid.

NOTE

MIL-PRF-46170, Type II for aircraft hydraulic component storage will no longer be available. Aircraft hydraulic system parts may use the functional fluid used in that aircraft, i.e., MIL-PRF-83282, MIL-PRF-87257, or MIL-PRF-5606 for component storage. When used as component storage fluids, MIL-PRF-83282, MIL-PRF-87257, and MIL-PRF-5606 do not require draining prior to the component being installed on the aircraft. Contact appropriate System Program Office (SPO) for recommended alternate fluid for storage.

b. Individually serviced components will be sampled in a similar manner. If the fluid contains foreign matter, it will be drained to the point where clean fluid is encountered and the reservoir replenished with new, designated fluid. If the brake system has been serviced with preservation fluid (MIL-PRF-6083 or MIL-PRF-46170) for storage purposes, this fluid will be satisfactory for retention in system when the aircraft is prepared for a onetime flight.

c. When preparing individual hydraulic system parts such as filters, valves, and pumps for shipment or storage, the parts will be flushed internally with the hydraulic fluid utilized by the aircraft system, drained to the drip point and plugged. Ensure the fluid type is clearly annotated on a DD Form 1574 Serviceable Tag or equivalent. Prior to installation in the hydraulic system, the parts will be filled, drained and serviced with the same type of fluid utilized by the aircraft system. If the storage fluid is the same as the operational system fluid, the components do not require flushing prior to installation.

NOTE

MIL-PRF-46170, Type II for aircraft hydraulic component storage will no longer be available. Aircraft hydraulic system parts may use the functional fluid used in that aircraft, i.e., MIL-PRF-83282, MIL-PRF-87257, or MIL-PRF-5606 for component storage. When used as component storage fluids, MIL-PRF-83282, MIL-PRF-87257, and MIL-PRF-5606 do not require draining prior to the component being installed on the aircraft. Contact appropriate SPO for recommended alternate fluid for storage.

d. If preparing individual hydraulic system parts for shipment or storage and a preservation hydraulic fluid, Specification MIL-PRF-6083 or MIL-PRF-46170 is utilized, the following procedure should be implemented:

The parts will be flushed internally with flushing fluid, drained, flushed again with the preservation hydraulic fluid (MIL-PRF-6083 or MIL-PRF-46170) drained to the drip point and plugged. These parts must be tagged with the preservative used. Prior to installation in the hydraulic system, these parts will be filled and drained with the same type of fluid to be utilized by the aircraft system to flush it, filled again and a sample of the second fill must be forwarded to an Aerospace Fuels Laboratory for analysis to assure that the barium content is at an acceptable concentration. For questions and information on where to send the sample, contact DET 3, WR-ALC/AFTT, 2430 C STREET, BLDG 70, AREA B, WRIGHT-PATTERSON AFB OH 45433-7632, DSN 785-8050.

e. If the hydraulic fluid used in the shipping and storage of parts is unknown or it is suspect of having been preserved with MIL-PRF-6083 or MIL-PRF-46170 hydraulic fluids, a sample must be taken as specified in Step d and forwarded for analysis prior to being installed in the hydraulic system.

CHAPTER 8
PURGING PROCEDURES FOR HYDRAULIC EQUIPMENT

8.1 CONDITIONS FOR PURGING.

Various conditions may arise which require draining and flushing of fluid from hydraulic equipment. The miscibility of fluids listed in Table 8-1 is to be used as a guide, not as the criteria for flushing. The Air Force Petroleum Office, Weapon Systems Support Branch will be contacted on the flushing of fluids not specifically covered in applicable technical manuals.

8.2 EVIDENCE OF CONTAMINATION.

(See Paragraph 9.1.) This condition involves draining the contaminated fluid from the affected system or component and servicing with new, designated, hydraulic fluid of the same type.

8.3 IMPROPER SERVICING.

If an aircraft hydraulic system or component requiring a specific fluid for normal operation has been serviced with another type fluid, the fluid will be immediately drained from the affected equipment and discarded. The hydraulic filter elements will be removed and tagged. New filters will be drawn from stock for installation in accordance with applicable instructions. If fluids are Miscible (M) (see Table 8-1), drain and refill with proper fluid. If fluids are Non-Miscible (NM) (see Table 8-1), the system will be drained, flushed and reserviced as follows:

NOTE

Hydraulic fluids and flushing fluids will not be disposed of in the sanitary and storm sewers, or open ditches. Contact the Base Civil Engineer or the Environmental Coordinator for approved methods of disposal.

a. Drain and dispose of the fluid from the affected equipment.

b. Remove all hydraulic filter elements. The paper type elements are to be tagged as administratively condemned property. It is recommended that wire mesh filters (cleanable type) be tagged as repairable property. Do not attempt to clean at field level.

c. Flush the systems with the designated hydraulic fluid and operate flight controls and utilities (rudder, ailerons, landing gear, etc.) through at least ten cycles.

d. Drain and discard the flushing fluid.

e. Replace the hydraulic filter elements with new ones and service with new designated fluid.

f. Perform at least one operational flight.

g. Drain and reservice with new designated fluid. Reclaim the fluid as indicated in Paragraph 5.1.

8.4 CONVERSION FROM MIL-PRF-5606 TO MIL-PRF-87257 HYDRAULIC FLUID.

Most USAF aircraft still using MIL-PRF-5606 hydraulic fluid are being converted to MIL-PRF-87257 fire resistant hydraulic fluid. If conversion is by attrition, mixing of MIL-PRF-5606 and MIL-PRF-87257 is permitted. If conversion is on a non-attrition basis, no mixing of fluids is allowed and procedures in Paragraph 8.5 must be followed to flush test stands and servicing carts.

8.5 PURGING PROCEDURES FOR TEST STANDS AND SERVICING CARTS.

a. Test Stands.

NOTE

MIL-PRF-5606, MIL-PRF-83282 and MIL-PRF-87257 are totally miscible and compatible. Test stand reservoir must be in vented position. If test stand is equipped with reservoir pressure shut down switch, switch will require deactivation for accomplishment.

(1) Place reservoir selector valve to test stand position. Open flow control and bypass valves.

(2) Drain hydraulic fluid from reservoir into a suitable container by removing drain plug.

(3) Disconnect hoses from the test stand and the weapon system. Remove the quick-disconnects to permit draining of hoses. Install quick-disconnects when draining is complete.

(4) Disconnect high-pressure hose at test stand going to high-pressure filter (if used) and drain both hose and test stand.

(5) Drain high-pressure filters and low-pressure filters by removing drain plugs. Remove/replace filter elements and install filter bowls and caps.

(6) Remove fill system and case drain (if used) filter bowls and drain. Remove/replace filter elements and reinstall bowls.

(7) Drain high-pressure pumps by removing case drain plugs. Prior to start-up of system, ensure that pressure demands are slowly brought to working pressure in order to eliminate damage to the pump.

(8) Drain oil coolers by removing drain plugs or if hoses are installed by loosening the B nuts. Loosen the -24 metal line from the reservoir selector valve at the TEE connection end drain.

(9) Tighten all connections, install all drain plugs, and connect service hoses in a runaround position.

(10) Replenish the reservoir with 20 gallons of specified fluid.

(11) Operate fill system to ensure that all components are filled with fluid. Start test stand (see Step (7)) in accordance with applicable technical order. Operate in an open loop configuration to allow fluid to circulate through service hoses and returning to test stand reservoir at five GPM for five minutes.

(12) Shut test stand down and drain all systems as before and install filter elements.

(13) Install drain plugs and tighten all connections that were loosened.

(14) Fill reservoir with specified fluid. Operate fill system to ensure that all systems are filled with fluid and operate test stand as before for ten minutes at five GPM. Correct all leaks. Perform Step b to verify conversion of fluids are acceptable.

b. Special Instructions for Conversion from MIL-PRF-5606 to MIL-PRF-87257.

(1) Extract a fluid sample and conduct flash point test utilizing ASTM D 92. Refer to Chapter 10 for examples of different flash point tests. Flash point temperature shall be 320°F minimum. If flash point temperature is not acceptable, drain and refill reservoir with MIL-PRF-87257. Circulate fluid as before and conduct another flash point test.

(2) Mark test stand in accordance with instructions contained in TO 35-1-3, Corrosion Prevention, Painting and Marking of USAF Support Equip (SE), identifying MIL-PRF-87257.

c. Servicing carts (for servicing aircraft).

(1) Drain and discard the hydraulic fluid as specified in Paragraph 5.1.

(2) Remove all filter elements and tag as specified in Paragraph 8.3, Step b.

(3) Fill the system with the new hydraulic fluid and drain thoroughly as specified in Paragraph 8.3, Step d.

(4) Install new filter elements and fill with the new hydraulic fluid.

(5) Use for servicing aircraft IAW applicable technical manuals.

Table 8-1. Miscibility of Hydraulic Fluids

Specification	Water	Petroleum (mineral)	Silicone	Organo-Phosphorous	Synthetic Hydrocarbons	Esters
VV-D-1078	NM	NM	M	NM	NM	NM
AS 1241	NM	NM				
MIL-PRF-5606	NM	M	NM	NM	M	M
MIL-PRF-6083	NM	M	NM	NM	M	M
MIL-DTL-17111	NM	M	NM	NM	M	M
MIL-PRF-17672	NM	M	NM	NM	M	M
MIL-H-19457	NM	NM	NM	M	M	M
MIL-H-22072	M	NM	NM	NM	NM	NM
MIL-PRF-27601	NM	M	NM	NM	M	M
A-A-59354	NM	M	NM	NM	M	M
MIL-PRF-46170	NM	M	NM	NM	M	M
MIL-PRF-46176	NM	NM	M	NM	NM	NM
MIL-H-81019	NM	M	NM	NM	M	M
MIL-PRF-83282	NM	M	NM	NM	M	M
MIL-PRF-87257	NM	M	NM	NM	M	M

M – Miscible: No visible turbidity, cloudiness, sediment or haziness when two different fluids become mixed.

NM – Non-Miscible: When two different fluids will not mix.

NOTE

The miscibility of the hydraulic fluids listed in this table, does not imply that the hydraulic fluids are compatible or interchangeable.

CHAPTER 9
INSPECTION DURING OVERHAUL OR DISASSEMBLY

9.1 INSPECTION.

a. Inspection of the hydraulic system or components will be made during overhaul. During normal operation, hydraulic systems can become contaminated with metallic and nonmetallic particles. Particulate contamination may result from internal wear, failure of system components, or incorrect maintenance and servicing operations. In the event the fluid shows evidence of accumulated dirt or foreign matter, the entire system will be drained, flushed and refilled with new fluid.

b. Fluid drained for any reason from an aircraft hydraulic system or component will not be reused. Fluid will be disposed of in accordance with instructions contained in Paragraph 5.1.

CHAPTER 10
DESIGNATED HYDRAULIC FLUIDS FOR AIR FORCE AIRCRAFT

10.1 CHOICE OF HYDRAULIC FLUID.

The designation of a hydraulic fluid for any aircraft hydraulic system remains the joint responsibility of the MAJCOMs operating the aircraft and the appropriate AFLC System Program Office (SPO). The compilation of data in Table 10-1 is dependent upon input from MAJCOMs and SPOs and is presented here only to provide a quick reference to all aircraft hydraulic fluid needs in a single document. In the event of a conflict between this technical order and the aircraft technical order, the guidance in the aircraft technical order shall prevail and DET 3 WR-ALC/AFTT should be advised to change this technical order accordingly.

10.2 DETERMINATION OF PERCENT MIL-PRF-83282 IN MIL-PRF-83282/MIL-PRF-5606 MIXTURES.

Percent MIL-PRF-83282 in MIL-PRF-83282/MIL-PRF-5606 mixtures can be determined with reasonably accurate results by testing flash point utilizing ASTM D 92 (FLASH AND FIRE POINTS BY CLEVELAND OPEN CUP).

10.3 DETERMINATION OF PERCENT MIL-PRF-87257 IN MIL-PRF-87257/MIL-PRF-83282 MIXTURES.

Percent MIL-PRF-87257 in MIL-PRF-87257/MIL-PRF-83282 mixtures can be determined with reasonable results by testing flash point utilizing ASTM D 92 and viscosity, ASTM D 445. However, low temperature viscosity measurements on used or non-fresh hydraulic fluids can lead to significantly skewed results due to the presence of water that may not be dissolved at these lower temperatures. A better method to determine the composition of these hydraulic fluid mixtures is by analyzing a sample of the mixture on a gas chromatograph equipped with a capillary column.

10.4 CHLORINE, WATER, AND BARIUM LIMITS IN HYDRAULIC SYSTEMS.

The current data does not allow specific and mandatory use limits governing chlorine, water and barium contamination in all of the many aircraft hydraulic systems. As a general rule, hydraulic fluid should be drained and replaced when area laboratory analysis shows chlorine to exceed 200 PPM, barium to exceed 20 PPM, and water to exceed 250 PPM for MIL-PRF-5606 or 350 PPM for MIL-PRF-83282 or MIL-PRF-87257. Those limits are only suggested limits and MAJCOMs and AFLC SPOs may make use limits either more stringent or more relaxed as further data and experience is acquired.

Table 10-1. Designated Hydraulic Fluids for Air Force Aircraft

Aircraft	System Nomenclature	Volume (GL)	Preferred Fluid	Percent Purity	Alternate Fluid
B-1B	#1 HYD SYS	12.0	MIL-PRF-87257	100%	MIL-PRF-5606
	#2 HYD SYS	20.0			
	#3 HYD SYS	20.0			
	#4 HYD SYS	12.0			
HH-1H	MAIN HYD SYSTEMS	1.56	MIL-PRF-83282	90% MIN	MIL-PRF-5606
	UTILITY HYD SYS	0.7			
	ROTOR BRAKE MASTER CYL	0.75 PINT			
TH/UH-1F/P	HYD FLUID RES	4.0 PINTS	MIL-PRF-83282	90%	MIL-PRF-5606
UH-1N	HYD SYS #1 RES	1.56	MIL-PRF-83282	90% MIN	MIL-PRF-5606
	HYD SYS #2 RES	1.17			
	ROTOR BRAKE MASTER CYLINDER	0.75 PINT			
O-2A/B	HYD SYS INCLUDING BRAKE	1.00	MIL-PRF-83282	90% MIN	MIL-PRF-5606
E-3B/C	UTILITY SYS	35.0 (TOTAL ALL SYSTEMS) **NOTE** UTILITY AND AUXILIARY SYSTEMS SERVICED THROUGH THE UTILITY.	MIL-PRF-87257	100%	MIL-PRF-5606
	(LANDING GEAR ACTUATION)				
	(BRAKE)				
	(LEADING EDGE FLAPS)				
	(ROTODROME LT DRIVE)				
	(TRAILING EDGE FLAPS)				
	(OUTBOARD SPOILERS)				
	(NOSE GEAR STEERING)				
	AUXILIARY SYS				
	(AIR REFUELING RECEIVER SYS)				
	(ROTODROME RT DRIVE)				
	(AUX POWER UNIT START SYS)				
	(INBOARD SPOILERS)				
	(RUDDER PWR CONTROL SYS)				
	MLG STRUTS (2 ea.)	18.0	MIL-PRF-87257	90%	NONE
	NLG STRUT	2.0			

Table 10-1. Designated Hydraulic Fluids for Air Force Aircraft - Continued

Aircraft	System Nomenclature	Volume (GL)	Preferred Fluid	Percent Purity	Alternate Fluid
CH/HH-3B/C/E	PRIMARY FLUID TANK	0.45	MIL-PRF-83282	90% MIN	MIL-PRF-5606
	AUXILIARY FLUID TANK	0.45			
	UTILITY FLUID TANK	1.29			
	ROTOR BRAKE RES	0.025			
	DAMPER FLUID TANK	0.30			
	MAIN WHEEL SHOCK STRUT	0.85			
	NOSE WHEEL SHOCK STRUT	0.75			
	LT WHEEL BRAKE SYS	0.064			
	RT WHEEL BRAKE SYS	0.045			
E4-B	HYDRAULIC SYSTEM 1	172.0 (TOTAL FOR SYSTEMS 1, 2, 3 & 4)	SAE AS 1241	100%	SKYDROL-LD-4 OR HYJET IV
	(LT IN/OUTBOARD AILERONS)				
	(LT CENT LAT CTRL ACTR)				
	(LT OUTBOARD ELEV)				
	(RT INBOARD ELEV)				
	(INBOARD TRLG EDGE FLAPS)				
	(UPPER RUDDER)				
	(STAB TRIM AUX HYD MOTOR PUMP)				
	(NOSE GEAR ACTR AND STEERING)				
	HYDRAULIC SYSTEM 2				
	(LT CENT LAT CTRL ACTR)				
	(LT STAB TRIM MODULE)				
	(LT OUTBOARD AILERON)				
	(RT INBOARD ELEV)				
	(RT INBOARD AILERON)				
	(SPOILERS 2, 3, 10, 11)				
	(LOWER RUDDER)				
	HYDRAULIC SYSTEM 3				
	(LT INBOARD AILERON)				

Table 10-1. Designated Hydraulic Fluids for Air Force Aircraft - Continued

Aircraft	System Nomenclature	Volume (GL)	Preferred Fluid	Percent Purity	Alternate Fluid
	(LT INBOARD ELEV)				
	(RT OUTBOARD AILERON)				
	(RT CENT LAT CTRL ACTR)				
	(RT STAB TRIM MODULE)				
	(SPOILERS 1, 4, 9 12)				
	(UPPER RUDDER)				
	HYDRAULIC SYSTEM 4				
	(LT INBOARD ELEV)				
	(RT INBOARD ELEV)				
	(RT OUTBOARD AILERONS)				
	(RT CENT LAT CTRL ACTR)				
	(RT OUTBOARD ELEV)				
	(SPOILERS 5, 6, 7 8)				
	(OUTBOARD TRLG EDGE FLAPS)				
	(LOWER RUDDER)				
	OTHER SYSTEMS	100.0 (TOTAL ALL SYSTEMS)			
	(STAB CRTL SYS ACTR)	(1.0)	MIL-PRF-5606	100%	NONE
	(INBOARD TRLG EDGE FLAP SYS TRANSMISSIONS)	(2.84)			
	(OUTBOARD TRLG EDGE FLAP SYS TRANSMISSIONS)	(1.72)			
	(ARC-96 WINCH RESERVOIR)	(4.1)			
	(NOSE RADOME HING SNUBBERS)				
	(WING GEAR SHOCK STRUT) (2)	(43.0)	MIL-PRF-5606	90%	MIL-PRF-6083
	(MLG SHOCK STRUT) (2)	(25.0)			
	(NLG SHOCK STRUT) (1)	(9.0)			
F-4 (ALL)	POWER CTRL SYS I	5.8	MIL-PRF-83282	90% MIN	MIL-PRF-5606
	POWER CTRL SYS II	5.8			
	UTILITY SYS	12.2			

Table 10-1. Designated Hydraulic Fluids for Air Force Aircraft - Continued

Aircraft	System Nomenclature	Volume (GL)	Preferred Fluid	Percent Purity	Alternate Fluid
	ARRESTING GEAR	1.5			
	MLG SHOCK STRUT, WET	10.7 PINTS	MIL-PRF-46170, TYPE I	90% MIN	MIL-PRF-6083
	MLG SHOCK STRUT, DRY	9.0 PINTS			
	NLG SHOCK STRUT	1.8			
C-5A/B	ALL SYSTEMS	265.0	MIL-PRF-83282	100%	NONE
	MLG SHOCK STRUTS	(13)			
	NLG STRUTS	(10)			
RF/F-5A/ B/E/F	FLT CTRLS HYD SYS RES	1.23	MIL-PRF-83282	90%	MIL-PRF-5606
	UTILITY HYD SYS RES	1.23			
	CANOPY DAMPER	0.023			
	MLG SHOCK STRUTS	0.38			
	NLG SHOCK STRUT	0.19			
RF/F-5E/F ONLY	ARRESTING HOOK DAMPER	0.037			
C-6A	ALL SYSTEMS	1.5	MIL-PRF-5606	100%	NONE
A-7D/K	NOSE GEAR SHOCK STRUT	1.20	MIL-PRF-83282	90% MIN	MIL-PRF-5606
	MAIN GEAR SHOCK STRUT	0.60			
	ARRESTING GEAR ACT	0.25			
	LATERAL VISCOUS DAMPER	0.018			
	AFT VISCOUS DAMPER	0.015			
	FORWARD VISCOUS DAMPER	0.018			
	PC NO. 1 RES	0.77			
	PC NO. 2 HYD SYS	11.6			
	PC NO. 2 RES	3.97			
	PC NO. 3 HYD SYS	3.36			
	PC NO. 3 RES	0.76			
A-7D ONLY	CANOPY ACT	0.030			
	PC NO. 1 HYD SYS	3.74			
A-7K ONLY	PC NO. 1 HYD SYS	3.29			
C-7A	HYD SYS RES	1.52	MIL-PRF-83282	90% MIN	MIL-PRF-5606

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Table 10-1. Designated Hydraulic Fluids for Air Force Aircraft - Continued

Aircraft	System Nomenclature	Volume (GL)	Preferred Fluid	Percent Purity	Alternate Fluid
VC/C-9A/C	ALL SYSTEMS	12.0	SAE AS 1241	100%	SKYDROL 500B-4
A-10A	#1 SYS LEFT-HAND	9.0	MIL-PRF-83282	95% MIN	MIL-PRF-5606
	#2 SYS RIGHT-HAND	9.0			
	MLG STRUT	9.0 PINTS		70%	
	NLG STRUT	9.0 PINTS			
KC-10A	ALL SYSTEMS	144	SKYDROL 500B-4	100%	SKYDROL LD-4
OV-10A	HYD SYS INCLUDING BRAKE	1.50	MIL-PRF-83282	90% MIN	MIL-PRF-5606
UC/C-12A/D/F	BRAKE SYS	0.25	MIL-PRF-5606	100%	NONE
F-15A/B/C/D/E	PC1 HYD SYS	4.6	MIL-PRF-83282	95% MIN	MIL-PRF-87257
	PC2 HYD SYS	4.6			
	UTILITY	14.5			
	MLG SHOCK STRUT	5 PINTS 9 OZ			
	NLG SHOCK STRUT	8 PINTS 13 OZ			
	ARRESTING HOOK DAMPER	1 PINT 5 OZ			
F-16A/B/C/D	SYS A	5.0	MIL-PRF-83282	NO LIMIT	MIL-PRF-5606
	SYS B	7.1			
C-17	#1 HYD SYS	6.7	MIL-PRF-83282	90% MIN	NONE
	#2 HYD SYS	11.7			
	#3 HYD SYS	7.8			
	#4 HYD SYS	6.7			
	PITCH TRIM ACTUATOR	0.850	MIL-PRF-83282		MIL-PRF-5606
C-18A	UTILITY SYS	35.0 (TOTAL BOTH SYSTEMS)	SAE AS 1241	100%	SKYDROL 500B-4
	AUXILIARY SYS				
	GEAR BOXES	0.5 PINT			
	SNUBBERS	0.5 PINT			
	MLG STRUTS (2 ea.)	12.0 (TOTAL)	MIL-PRF-5606	100%	NONE
	NLG STRUT	2.0			
UV-18B	HYD SYSTEM	1.50	MIL-PRF-83282	90%	MIL-PRF-5606
C-20A	COMBINED SYS	15.5	HYJET IV	100%	SKYDROL LD-4

Table 10-1. Designated Hydraulic Fluids for Air Force Aircraft - Continued

Aircraft	System Nomenclature	Volume (GL)	Preferred Fluid	Percent Purity	Alternate Fluid
	FLIGHT SYS	4.5			
	MLG STRUTS (2 ea.)	2.0	MIL-PRF-5606	90%	MIL-PRF-83282
	NLG STRUT	3.4 PINTS			
C-21A	ALL SYSTEMS	3.03	MIL-PRF-5606	100%	NONE
F/A-22	#1 HYD SYS (including RES servicing)	15.2	MIL-PRF-83282	100%	NONE
	#2 HYD SYS (including RES servicing)	16.5			
	#1 HYD SYS (no RES servicing)	10.4			
	#2 HYD SYS (no RES servicing)	11.8			
OA/A-37B	ALL HYD SYSTEMS	1.08	MIL-PRF-83282	90% MIN	MIL-PRF-5606
	MLG SHOCK STRUTS (2 ea.)	50.0 OZ (TOTAL)			
	NLG SHOCK STRUT	12.0 OZ			
	BRAKE	0.0283			
T-37B/C	ALL SYSTEMS	1.08	MIL-PRF-5606	90% MIN	MIL-PRF-83282
	BRAKE	0.0283			
	MLG SHOCK STRUTS (2 ea.)	52 OZ (TOTAL)			
	NLG SHOCK STRUTS	12 OZ			
T-38A/B/C	FLT CTRLS HYD RES	1.25	MIL-PRF-5606	90% MIN	MIL-PRF-83282
	UTILITY HYD SYS RES	1.25			
	BRAKES (10 THRU 35)	0.20			
	BRAKES (40 AND LATER)	0.10			
	CANOPY DAMPER	0.023			
	MLG STRUTS	0.38			
	NLG STRUT	0.19			
CT/T-39A/B/F	ALL SYSTEMS (EXCEPT STRUTS)	6.5	MIL-PRF-83282	90% MIN	MIL-PRF-5606
	STRUTS	1.0 PINT	MIL-PRF-5606	100%	NONE
T-41A/C/D	ALL SYSTEMS		MIL-PRF-5606	100%	NONE
T-43A	HYD RES A, B AND STANDBY	11.0	SAE AS 1241	100%	SKYDROL 500B-4
	MLG STRUTS	5.0	MIL-PRF-5606	100%	NONE
	NLG STRUT	3.0			
	FLAP TRANSMISSION GEARBOX	6.0 PINTS			

Table 10-1. Designated Hydraulic Fluids for Air Force Aircraft - Continued

Aircraft	System Nomenclature	Volume (GL)	Preferred Fluid	Percent Purity	Alternate Fluid
T-46A	ALL SYSTEMS		MIL-PRF-83282	90%	MIL-PRF-5606
	BRAKE				
B-52G/H	#1 RUDDER/ELEV	2.1	MIL-PRF-87257	100%	MIL-PRF-5606
	#2 RUDDER/ELEV	2.1			
	LT OUTBOARD WING	3.5			
	RT OUTBOARD WING	3.5			
	LT INBOARD WING	3.5			
	RT INBOARD WING	3.5			
	LT BODY	7.7			
	RT BODY	7.7			
	MLG STRUTS (4 ea.)	5.0 ea			
	TIP PROT GEAR STRUTS (2 ea.)	2.1 ea			
CH/HH-53B/C/H	FIRST STAGE SYS FLUID TANK	0.39	MIL-PRF-83282	90% MIN	MIL-PRF-5606
	SECOND STAGE SYS FLUID TANK	0.39			
	UTILITY SYS FLUID TANK	3.67			
	MAIN WHEEL SHOCK STRUT	1.6			
	NOSEWHEEL SHOCK STRUT	1.7			
	DAMPER FLUID TANK	0.82			
	ROTOR BRAKE RES	0.09			
UH/HH-60A/D/E	FIRST STAGE HYD RES	0.25	MIL-PRF-83282	90% MIN	MIL-PRF-5606
	SECOND STAGE HYD RES	0.25			
	BACKUP HYD RES	0.25			
F-86 (ALL MODELS)	ALL SYSTEMS	7.0	MIL-PRF-83282	90%	MIL-PRF-5606
	MLG SHOCK STRUT	3.0			
	NLG SHOCK STRUT	2.4			
KC-97L	ALL SYSTEMS		MIL-PRF-5606	100%	NONE
F-100D/F	ALL SYSTEMS	8.0	MIL-PRF-83282	90%	MIL-PRF-5606
F-104G F-104(T)G	SYS 1 AND SYS 2	7.59	MIL-PRF-83282	90%	MIL-PRF-5606
F-106A/B	PRIMARY HYD SYS	4.03	MIL-PRF-5606	100%	NONE

Table 10-1. Designated Hydraulic Fluids for Air Force Aircraft - Continued

Aircraft	System Nomenclature	Volume (GL)	Preferred Fluid	Percent Purity	Alternate Fluid
	SECONDARY HYD SYS	6.43 or 7.01			
	RTM HYD SYS	0.684			
	BRAKE RES (2 ea.)	0.30			
	MLG SHOCK STRUT (2 ea.)	4.70			
	NLG SHOCK STRUT	0.406			
EF/F-111A/ D/E/F/G	PRIMARY HYD SYS	11.0	MIL-PRF-83282	90% MIN	MIL-PRF-5606
	UTILITY HYD SYS	24.0			
	OTHER SYSTEMS	2.0 (TOTAL)	MIL-PRF-5606	70% MIN	MIL-PRF-83282
	(ARRESTING HOOK DASH POT)				
	(TAIL BUMPER DASH POT)				
	(NLG STRUT)	(0.6)			
	(MLG STRUTS)	(0.845)			
FB-111A	PRIMARY SYS	11.0	MIL-PRF-83282	70% MAX	MIL-PRF-5606
	UTILITY SYS	24.0			
	OTHER SYSTEMS (ARRESTING HOOK DASH POT) (TAIL BUMPER DASH POT) (NLG STRUT) (MLG STRUT)	2.0	MIL-PRF-5606 (TOTAL)	70% MIN	MIL-PRF-83282
F-117A	UTILITY HYD SYSTEMS	23.9	MIL-PRF-83282	95% MIN	MIL-PRF-5606
	FLIGHT SYSTEMS	7.9			
	MLG STRUTS	1.6			
	NLG STRUT	1.0			
C/UC-123K	HYDRAULIC SYS RES	2.88	MIL-PRF-83282	90% MIN	MIL-PRF-5606
AC/C-130A	UTILITY SYS	10.0	MIL-PRF-87257	NO LIMIT	MIL-PRF-83282
	BOOSTER SYS	7.8			
	EMERGENCY SYS	13.5			
	FWD CARGO DOOR SYS	0.30			
C-130D	UTILITY SYS	25.0	MIL-PRF-87257	NO LIMIT	MIL-PRF-83282
	BOOSTER SYS	9.3			
	EMERGENCY SYS	9.7			

Table 10-1. Designated Hydraulic Fluids for Air Force Aircraft - Continued

Aircraft	System Nomenclature	Volume (GL)	Preferred Fluid	Percent Purity	Alternate Fluid
C-130B C-130E/H AC-130H EC-130E JC-130B MC-130E WC-130E	UTILITY SYS	12.5	MIL-PRF-87257	NO LIMIT	MIL-PRF-83282
	BOOSTER SYS	9.3			
	AUXILIARY SYS	3.4			
	FWD CARGO DOOR SYS	0.30			
HC-130H	UTILITY SYS	12.5	MIL-PRF-87257	NO LIMIT	MIL-PRF-83282
HC-130N/P WC-130H	UTILITY SYS	17.9	MIL-PRF-87257	NO LIMIT	MIL-PRF-83282
HC-130H/N/P WC-130H	BOOSTER SYS	9.3	MIL-PRF-87257	NO LIMIT	MIL-PRF-83282
HC-130H (UNMODI- FIED)	AUXILIARY SYS	3.4	MIL-PRF-87257	NO LIMIT	MIL-PRF-83282
HC-130H/N/P (MODIFIED)	AUXILIARY SYS	6.22	MIL-PRF-87257	NO LIMIT	MIL-PRF-83282
LC-130H	UTILITY SYSTEM	25.0	MIL-PRF-87257	NO LIMIT	MIL-PRF-83282
	BOOSTER SYSTEM	9.3			
	AUXILIARY SYSTEM	9.7			
C-130 (ALL MODELS)	PROPELLER SYS 54H60-91	6.5	MIL-PRF-87257	NO LIMIT	MIL-PRF-83282
C-131B/ D/E/H	ALL SYSTEMS	17.2	MIL-PRF-83282	90%	MIL-PRF-5606
C/KC-135 (ALL MODELS)	LT HYD SYS	21.5	MIL-PRF-87257	100%	NONE
	RT HYD SYS	27.6			
	GEAR BOXES	0.5 PINT			
	SNUBBERS	1.0 PINT			
	MLG STRUT	6.0			
	NLG STRUT	2.0			
C-137B/C	UTILITY HYD SYS	29.0 MODEL B 35.0 MODEL C (TOTAL BOTH SYSTEMS)	SAE AS1241	100%	SKYDROL 500B-4
	AUXILIARY HYD SYS				

Table 10-1. Designated Hydraulic Fluids for Air Force Aircraft - Continued

Aircraft	System Nomenclature	Volume (GL)	Preferred Fluid	Percent Purity	Alternate Fluid
	GEAR BOXES	0.5 PINT	MIL-PRF-5606	100%	NONE
	SNUBBERS	0.5 PINT			
	MLG STRUT	6.0			
	NLG STRUT	2.0			
C-140A/B	HYD SYS 1	3.5 MODEL A	MIL-PRF-83282	90%	MIL-PRF-5606
		4.3 MODEL B			
	HYD SYS 2	2.9			
C-141A/B	ALL SYSTEMS		MIL-PRF-83282	100%	NONE